

Aerosol-assisted synthesis of hierarchically organized titania and titanates nanostructures

Ivan M. Dugandžić¹, Dragana J. Jovanović², Lidija T. Mančić¹, Zoran V. Šaponjić², Jovan M. Nedeljković² and Olivera B. Milošević¹

¹Institute of Technical Science of SASA, Knez Mihailova 35-IV, 11000 Belgrade, Serbia

²Vinča Institute of Nuclear Sciences, University of Belgrade, 11001 Belgrade, Serbia

Introduction

❖ Spherical hierarchically organized titania (TiO₂) and titanates nanostructures with controllable properties such as crystal structure, particle size distribution and surface chemistry have proved versatility in series of applications.

Methods

Colloidal solution of Titania (TiO₂) nanoparticles

Colloidal solution of Titanates nanotubes

Aerosol processing

Hierarcically organized particles
Primary building units:
Titania nanoparticles

Hierarcically organized particles
Primary building units:
Titanates nanotubes

❖ Synthesis of hierarchically organized TiO₂ particles was preformed using the laboratory set-up for ultrasonic spray pyrolysis starting from colloidal precursor solution of either colloidal TiO₂ nanoparticles or colloidal nanotubes.

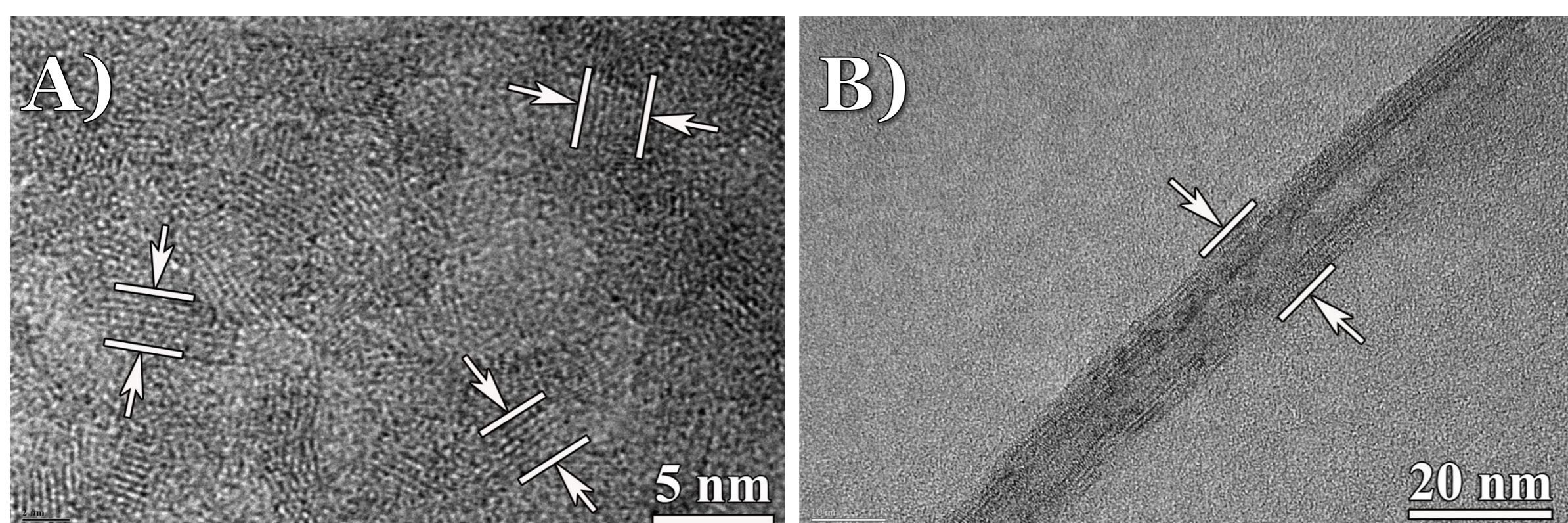


Figure 1. TEM images of precursor solutions: A) TiO₂ nanoparticles, B) titanates nanotubes

- ❖ TiO₂ nanoparticles (Figure 1.A) possess nearly spherical shape with an average diameter of ~4.5 nm.
- ❖ Titanates nanotubes (Figure 1.B) have open-ended multiwall shape with average dimensions of ~10 x 7 x 100 nm for outer, inner diameter and length, respectively.

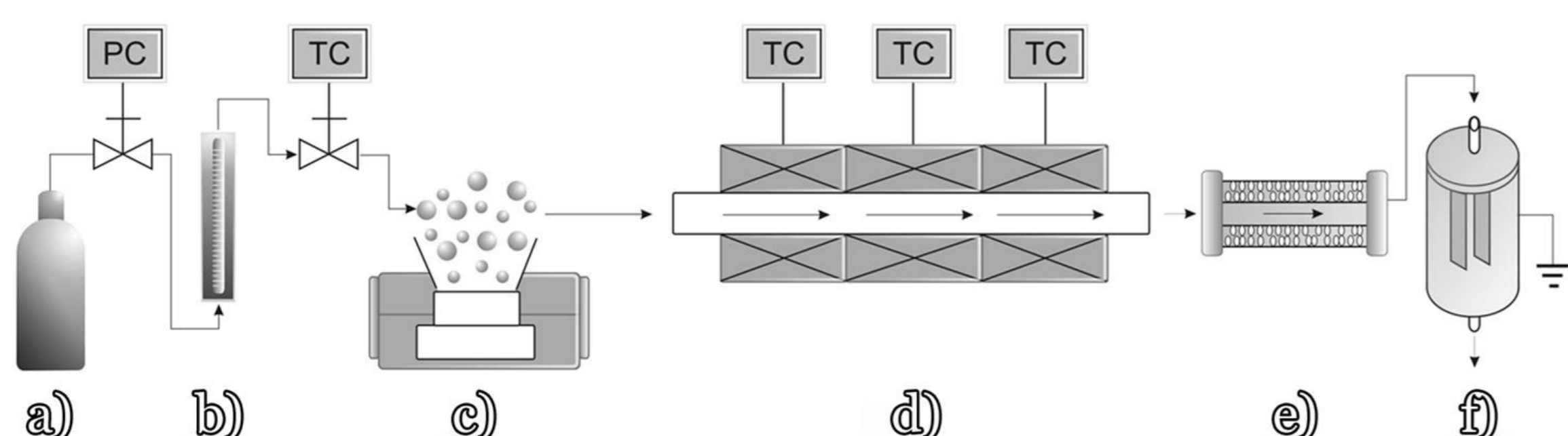


Figure 2. Schematic illustration of the experimental set-up of ultrasonic spray pyrolysis

- ❖ It consists of : (a) carrier gas, (b) flow meter ($F_G=2.00 \text{ dm}^3\text{min}^{-1}$), (c) ultrasonic atomizer (1.3 MHz), (d) hot-wall reactor ($T_w=150^\circ \text{ C}$), (e) diffusional dryer and (f) electrostatic precipitator.

Results and Discussion

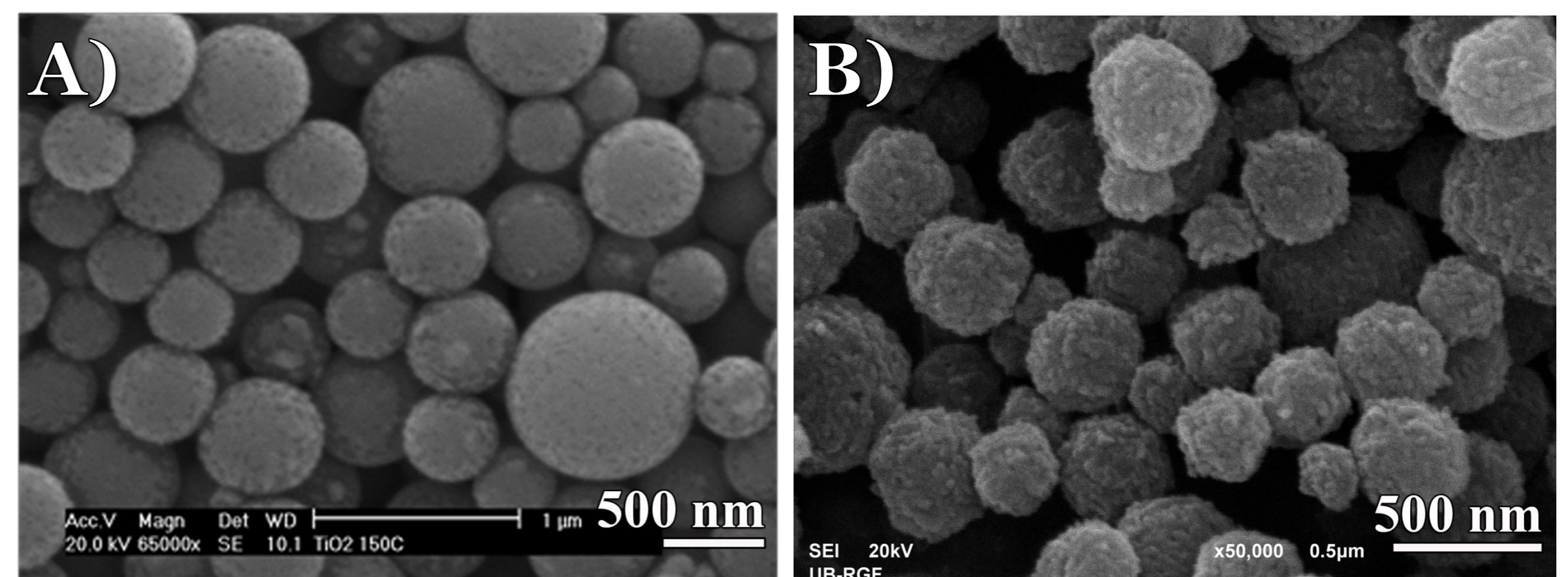


Figure 3. SEM images of hierarchically organized particles obtained from colloidal solution of A) TiO₂ nanoparticles and B) titanates nanotubes

- ❖ Show that synthesized particles are spherical in shape, non-agglomerated, uniform particle size distribution with the average particle diameter of ~430 nm (Figure 3.A) and ~330 nm (Figure 3.B).

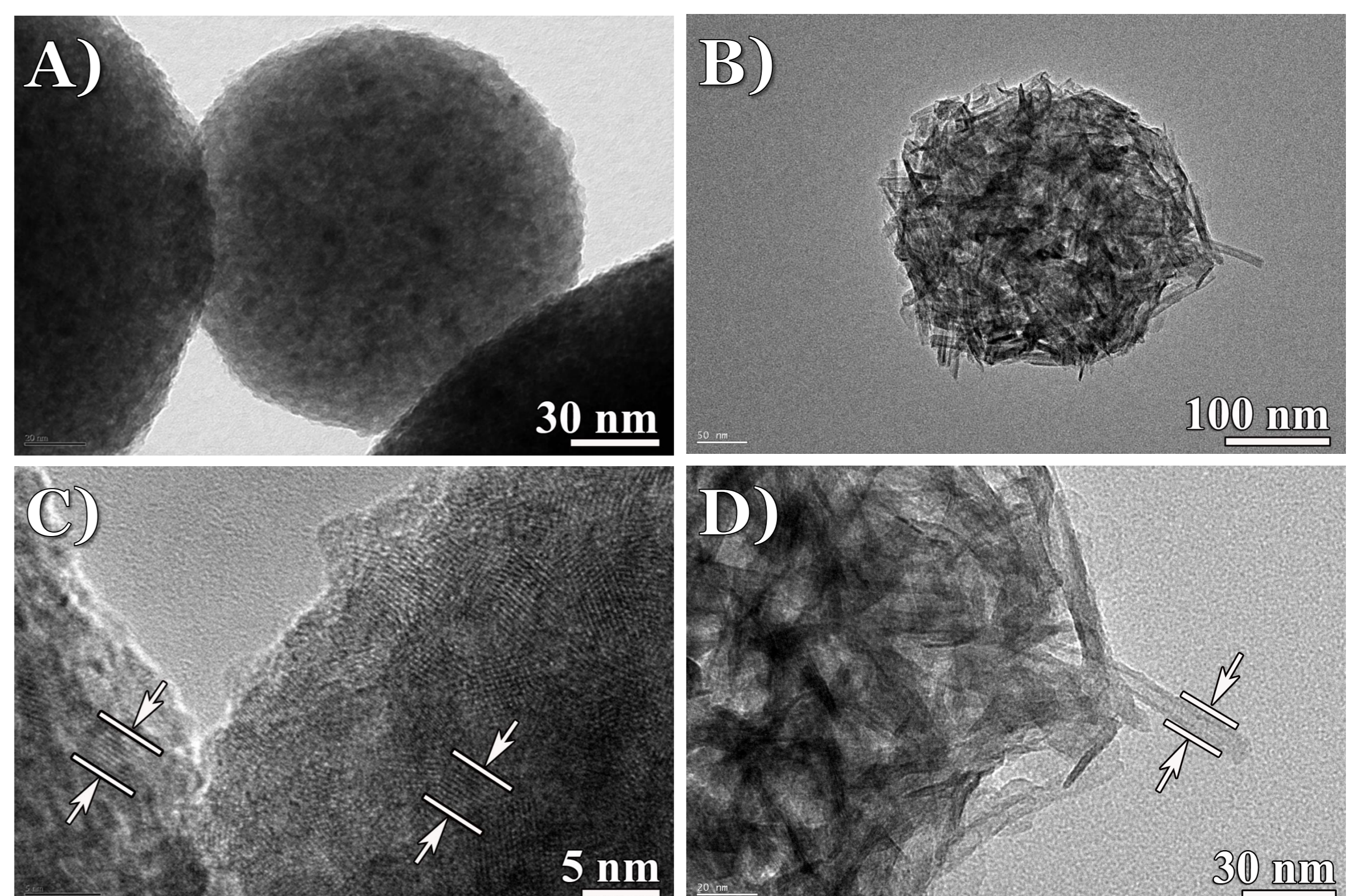


Figure 4. TEM images of hierarchically organized particles obtained from colloidal solution of A) TiO₂ nanoparticles and B) titanates nanotubes

- ❖ Confirm their spherical morphology (Figure 4.A, B) and indicate hierarchical order composed of primary subunits.
- ❖ A high magnification TEM images imply that size and shape of primary subunits did not change significantly from the corresponding precursors.(Figure 3.C, D).

Conclusion

- ❖ We present aerosol route towards obtaining of hierarchically organized TiO₂ particles which are expected to have potential application in photovoltaic technologies but also in various aspects of photocatalysis.

Acknowledgments: This research is financially supported through the project No. 45020 of the Serbian Ministry of Education, Science and Technological Development

ACA II, 30th September-1st October, Belgrade, Serbia